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(54) Title: VASCULARIZED PERFUSED MICROTISSUE/MICRO-ORGAN ARRAYS

(57) Abstract

Systems including (1) a micromatrix and perfusion assembly suitable for seeding and attachment of cells within the matrix and for morphogenesis of seeded cells into complex, hierarchical tissue or organ structures, wherein the matrix includes channels or vessels through which culture medium, oxygen, or other nutrient or body fluids can be perfused while controlling gradients of nutrients and exogenous metabolites throughout the perfusion path independently of perfusion rate, and (2) sensor means for detecting changes in either cells within the matrix or in materials exposed to the cells, have been developed. Methods for making the micromatrices include micromachining, micromolding, embossing, laser drilling, and electro deposition machining. Cells can be of one or more types, either differentiated or undifferentiated. In a preferred embodiment, the matrix is seeded with a mixture of cells including endothelial cells which will line the channels to form "blood vessels", and at least one type of parenchymal cells, such as hepatocytes, pancreatic cells, or other organ cells. The system can be used to screen materials for an effect on the cells, for an effect of the cells on the materials (for example, in a manner equivalent to tissue metabolism of a drug), or to test a material on a biological that must first infect cells or tissues, such as viruses. The apparatus also can be used to provide a physiological environment for expansion of stem cells, or for enabling gene therapy *in vitro*.